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SOVIET AVIATION TECHNOLOGY'S STATE OF THE ART SU-27
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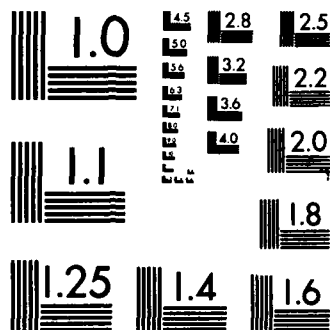
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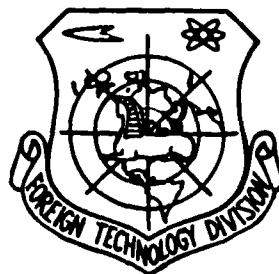


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by

Gong Fei

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HUMAN TRANSLATION

FTD-ID(RS)T-0528-87

15 July 1987

MICROFICHE NR: FTD-87-C-000527

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English pages: 8

Source: Conmlit, Vol. 1 , (Issue 122),
1 January 1987, pp. 61-62

Country of origin: China

Translated by: SCITRAN

F33657-84-D-0165

Requester: FTD/SDEO

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SOVIET AVIATION TECHNOLOGY'S STATE OF THE ART SU-27 FIGHTER

Gong Fei

►The SU-27 fighter makes use of avionics equipment representing the highest current level of Soviet technology and is estimated to be comparable in its overall capabilities to third generation U.S. fighters. What is attracting peoples' interest is whether or not the SU-27 is able to undertake long range interceptor missions or has been created as a medium-type fighter for loading aboard aircraft carriers. ◀

GENERAL EXPLANATION OF DEVELOPMENT

In 1977, U.S. reconnaissance satellites discovered, in Laminskaya in the Soviet Union, that that government was in the process of test producing three new types of fighters. The western nations named these respectively the Ram-J, Ram-K, and Ram-L. The aircraft designated the Ram-K was none other than the current SU-27. Some people believe that its true generational designation is MiG-31. It was designed by the Mikoyan Design Institute. On the basis of its fuselage configuration, it is estimated that it is a new type of swept wing fighter similar in type to the U.S. F-14 (Tomcat). At present, it is estimated that its basic property specifications are: overall takeoff weight of approximately 27 tons; length of 20 meters; wing spread of 12.5 meters; a maximum level flight speed at sea level of Mach 1.1; and, a combat weight to thrust ratio of 1.3. It is equipped with one aerial cannon and six AA-X-9 air-to-air missiles. Its advanced electronics equipment has a "down-look-down-firing" capability. Its fire control radar has a side sweep, side tracking capability with a search distance of more than 110 km and a tracking distance of approximately 30 km. At the present time, we are still presenting the conceptual diagram for the Ram-K.

In 1982, the western countries realized that this type of aircraft was certainly not designed by the Mikoyan Design Institute, but, was instead designed by the Sukhoi Design Institute, and its designation was changed to SU-27. The NATO countries selected for it the name Flanker.

At the end of 1983, magazines in countries such as the U.S. repeatedly published imagined blueprints for it and estimates of its capabilities. The SU-27 is evaluated as having two engines each of which has an impressed force thrust of approximately 13 tons. The aircraft thrust to weight ratio is 1.2, and its total takeoff weight is approximately 23.3 tons. The maximum flight speed for this aircraft is Mach 2.3-2.4 with an instantaneous angular velocity of turn of 23 degrees per second. It can withstand overloading of 7-9g, and its acceleration capabilities are 20% higher than those of the MiG-23. In 1985 several publications presented satellite photography of the SU-27.

On New Year's Eve 1985, Soviet television broadcast a short report relating to the SU-27. It explained that this aircraft would soon be or already was in service. Prototype tests on the SU-27 began to be carried out in 1977, and production began around the period 1980-81. It went into formal service in 1986. The process from prototype testing to service use required approximately ten years time. Comparing this to comparable aircraft in the U.S., such as the F-15 and F-14, the period required by the U.S. was somewhat longer. This is explained by the fact that the process of test production of the U.S. aircraft was relatively difficult. Western people estimate that the reason why the SU-27 was delayed in its being deployed in units was due to the problems associated with the electronics equipment loaded aboard the aircraft. These came during the same period of time when quite large modifications were also being made to the design plans (including the aerodynamic form and so on.)

ANALYSIS OF SPECIAL CHARACTERISTICS

According to the short news report which was carried on Soviet television concerning the SU-27 aircraft, it is possible to estimate that it has the characteristics below.

The SU-27 is a type of single seat, two engine interceptor and air superiority fighter. Its dimensions and weight are quite close to those of the F-15 aircraft. Its maximum flight speed is approximately Mach 2.3-2.4. Its operational radius is approximately 1500 km. The wings of the aircraft use a planar Delta configuration in a single top mounted wing. However, in the early phases of test production, it was decided to employ an often back swept design. The main aircraft wing

extension is 14.5 meters with the forward wing edge angle of back sweep being approximately 40 degrees. The wings of the aircraft have almost no high efficiency systems for adding lift. The wings on both sides each have two top mounted vertical stabilizer fins. The mass produced model of the SU-27 aircraft chose to eliminate these fins.

The SU-27 makes use of a twin tail fin design with a vertical tail stabilizer area which is relatively large. The position at which they are installed is between the main wing of the aircraft and the centrally positioned horizontal stabilizers. The vertical stabilizers are positioned leaning slightly forward. It is estimated that this type of arrangement is used with a view to the regulation of the surface area. The wing of the aircraft has no auxiliary control surfaces. It is totally from the movements of the horizontal stabilizing ailerons that roll, pitch and yaw are controlled. The root sections of the front edges of the main wing have a section extending forward to constitute the front edge of the fuselage. In the prototype aircraft of the SU-27 the vertical stabilizers were positioned right in the center of the flow covers of the engines. In the production model, the vertical stabilizers were moved toward the outer edges of the flow control covers.

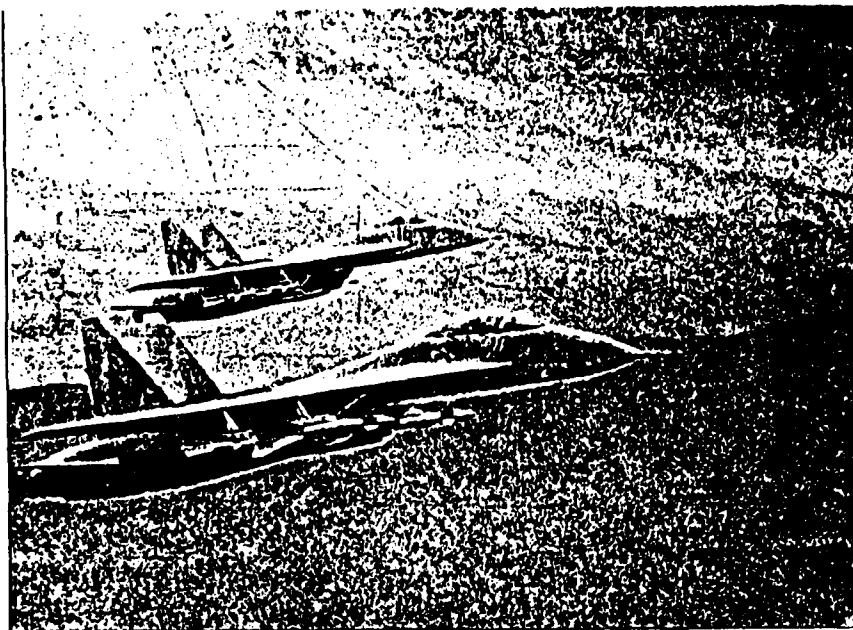
The cockpit of the SU-27 makes use of a bubble-type, one piece structure as the cockpit cover. The windshield is also a one piece structure with no supporting framework. This type of arrangement has very greatly improved the visibility of the pilot. The ejection seat uses a rearward slant of approximately 25 degrees. This improves the pilots ability to withstand high levels of overloading.

The SU-27 is equipped with two low function path ratio turbo-fan engines. This type of engine may possibly be a development type of the P-29 turbojet engine (used aboard the MiG-25). It may also be a newly manufactured one. The thrust of one engine is around the 13 ton level. The air intake is a square, two-dimensional gas intake path. Moreover, it is equipped with slanting panels which are capable of adjusting the air intake. The gap between the convergence and dispersion tubes is relatively large. This is advantageous to the

reduction of lower section drag in a cruise configuration. Inside the compartments suspended in the bottom corners of air intake paths, it is possible to load infra-red tracking equipment. The forward landing gear of the aircraft pulls up to the rear. Moreover, it is equipped with an anti-FOD protection system in order to prevent the low positioned air intake from being damaged by the taking in of objects from the outside. Single wheel type main landing gear are taken up into a wheel compartment on the outer edge of the engine compartment of the aircraft. The upper compartment door of the landing gear compartment has a concurrent function as a speed reduction panel.

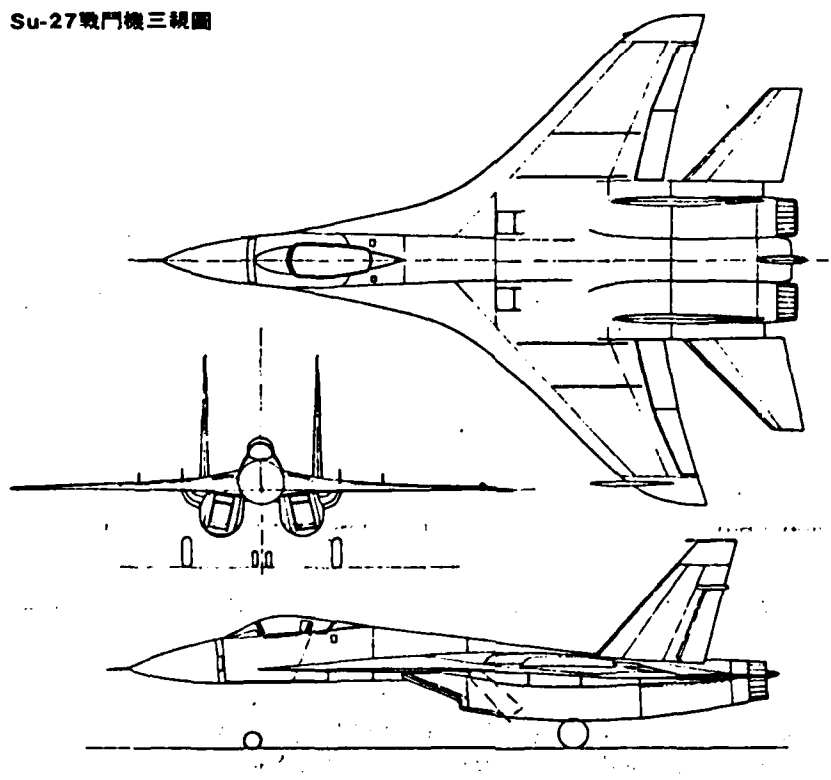
According to estimates, in a configuration in which both engines are at full thrust, the thrust to weight ratio of the SU-27 without any outside attachments is 1.3. In an aerial combat configuration in which the fuel inside the aircraft has been reduced by half, the thrust to weight ratio reaches higher than 1.5. This is one of the highest thrust to weight ratios among aircraft in use at the present time. The surface area of the wings of this aircraft is relatively large (52.5 square meters). The wing loading is relatively small (roughly equivalent to that of the F-15). In addition, the thrust to weight ratio of the aircraft is large. Moreover, the adoption for use of an advanced aerodynamic design consequently produces excellent aerodynamic properties. The table below sets out a comparison of the SU-27, the F-15, and the F-18. One can see from this table that the aerodynamic properties of the Soviet fighter are, in general, roughly equivalent to those of third generation U.S. fighters.

The armament of the SU-27 is aerial cannon and air to air missiles. In the original prototype of the SU 27, there were no aerial cannon specified. However, in the production model, it is possible to indicate that they have them. The SU-27 can carry 6 (some say 3) air to air missiles. Two infrared guided close range "hand to hand combat" missiles are capable of being mounted on the wing tips (the SU-27 production model altered the wing tips in order to make it more convenient to load missile firing racks.) Besides this, there are 4 newly test produced AA-10 medium range radar guided air to air missiles. It is estimated that this is similar to the U.S. "Advanced



A Conceptual Illustration of the SU-27 as Presented by the U.S. Defense Department. Fighter Armed With 4 AA-10 Air to Air Missiles

Su-27戰鬥機三視圖



A Three Plane View of the SU-27

	Su-27	F-15C	F-18A
翼展(米) ¹	14.5	13.05	12.32
機長(米) ²	20.0	19.43	17.07
機翼面積(米 ²) ³	52.50	56.48	37.16
發動機推力 ⁴	26,000	21,680	14,520
(加力:公斤) ⁵			
飛機總重(公斤) ⁶			
無外掛 ⁷	20,000	19,620	16,240
最大 ⁸	29,000	30,845	25,400
機內燃油量 ⁹	7,000	6,100	4,926
翼載荷(公斤/米 ²) ¹⁰			
最大 ¹¹	552	546	684
無外掛 ¹²	381	347	437
空戰 ¹³	314	293	371
推重比 ¹⁴			
最小 ¹⁵	0.9	0.7	0.57
無外掛 ¹⁶	1.3	1.1	0.89
空戰 ¹⁷	1.58	1.31	1.05
最大飛行速度 ¹⁸	M2.3~2.4	M2.5	M2.0
升限(米) ¹⁹	20,000	19,500	15,250
作戰半徑(公里) ²⁰	1,500	1,900	1,020

Comparison of Characteristics Between SU-27, F-15C, and F-18A 1. Wing Spread (meters) 2. Plane Length (meters) 3. Main Wing Surface Area (square meters) 4. Engine Thrust 5. (impressed thrust; kilograms) 6. Overall Aircraft Weight (kilograms) 7. Without Outside Attachments 8. Maximum 9. Amount of Fuel Inside Aircraft 10. Wing Loading (kilograms per square meter) 11. Maximum 12. Without Outside Attachments 13. Aerial Combat 14. Thrust to Weight Ratio 15. Minimum 16. No Outside Attachments 17. Aerial Combat 18. Maximum Flight Speed 19. Ceiling (meters) 20. Operational Radius (kilometers)

Medium Range Air to Air Missile". It has a capability such that there is no need to control the missile after launch. The AA-10 missile has a half covered form and is mounted in concave troughs between the two engines. This is similar to the way in which missiles are hung from the F-14 aircraft. When carrying out ground attack missions, the maximum missile carrying capability of the SU-27 is approximately 6000 kilograms.

The avionics equipment carried on the SU-27 aircraft is recognized by western countries as being worthy of note. In the past, it has been generally recognized that the electronics technology of the Soviet Union was 5-10 years behind that of the U.S. But, the appearance of the SU-27 makes it plain that this type of gap has already been greatly shortened. Certain people even believe that the gap has already disappeared. The fire control radar of the SU-27 makes use of a pulse balance Doppler system. It is estimated that its maximum search range is approximately 200 km and that its tracking range is approximately 100 km. It can eliminate random ground wave interference and possesses a "down look down shoot" capability. Moreover, it possesses side sweep side tracking capabilities as well as the ability to handle numerous targets. Also, an aircraft which is equipped with this type of multiple function radar and fire control system only requires one pilot to control it. This is another reason for saying that it has an advanced nature. To summarize all this, the form of its radar operations and the level of its technology are generally similar to the AWG-9 used on the U.S. F-14 aircraft, to the APG-63 used on the F-15 aircraft, and the APG-65 radar used on the F-18 aircraft. Its structure can be easily compared to a miniaturized APG-65. There are those who say that it makes use of technology that comes from the West. In terms of its control system, it is estimated that the SU-27 makes use of a digital type electrical transmission control system.

MISSIONS

The SU-27 is capable of being used to undertake the execution of air defense interceptor missions in the place of such aircraft as the SU-15 medium range interceptor and the TU-28 long range interceptor aircraft in order to take care of the U.S. B-1B and B-52 bombers as well as the cruise missiles carried aboard these two types of aircraft. According to reports, at the naval aviation bases of the

Baltic Fleet, this type of aircraft has also appeared. Because of this, it is estimated that the 65,000 ton class of nuclear powered aircraft carriers with a 300 meter long flight deck, which the Soviet Union is currently in the process of building, are designed to be equipped with this type of aircraft. If this is, in fact, the case, then, it is certainly a type of aircraft to pit against the U.S. F-14 and F-18. From the flight characteristics introduced above, and looking at the situation from the point of view of the fire control system and other equipment loaded aboard the aircraft, this plane has relatively strong aerial combat capabilities. It is capable of being used in air defense operations, and it is also capable of seizing air superiority and carrying out escort missions. Moreover, it has definite ground attack capabilities. Although the range of the SU-27 must be larger than that of the SU-15, when one considers the vast population of the Soviet Union and the length of its national boundaries, the using of the SU-27 to carry out long range intercept missions is definitely inappropriate.

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